CLAIMS

1. (Currently amended) A receiver for identifying a message based upon a received signal, the receiver comprising:

a processor that generates a minimum threshold and a maximum threshold representing a range for each of a plurality of possible message levels~~, wherein the sizes of the ranges are different for at least two of the message levels~~, and

a comparator that identifies the message by comparing the received signal with the generated minimum and maximum thresholds, wherein, for each of the possible message levels, the processor is adapted to: (A) determine a respective probability density function having a mean value and a spread; and (B) based on said mean value and said spread, generate the respective minimum threshold and the respective maximum threshold.

2. (Original) The receiver according to claim 1, wherein the minimum and maximum thresholds are a function of an interrelationship between noise and the message level.

3. (Original) The receiver according to claim 2, wherein the minimum and maximum thresholds are a function of the interrelationship between digital impairment and the message level.

4. (Original) The receiver according to claim 2, wherein the minimum and maximum thresholds are a function of the interrelationship between coherent noise and the message level.

5. (Currently amended) The receiver according to claim 1, wherein, for each of the possible message levels, the generated minimum and maximum thresholds define a respective range, which has ~~wherein~~ a probability of correctly identifying the respective message that ~~receiving a selected signal~~ exceeds a selected probability P0.

6. (Currently amended) The receiver according to claim 5, wherein the processor includes a means for calculating the respective mean value, Lev(i), for each message level, where i is an index that identifies an i-th message level ~~within a selected range defined by a selected set of minimum and maximum thresholds~~.

7. (Currently amended) The receiver according to claim 6, wherein the processor includes a means for calculating a distance d(i) between the i-th message level and an adjacent (i+1)-th message ~~received signal~~ levels, the distance d(i) being calculated according to the equation:

$$d(i) = Lev(i+1) - Lev(i) - Lmse(i+1) - Lmse(i),$$

~~wherein the term "i+1" identifies a message level adjacent the i^{th} message level in a constellation design for the receiver and wherein~~ where Lmse(i) is ~~the level~~ a mean square error associated with the spread of the probability density function for the i^{th} i-th message level, Lmse(i+1) is a mean square error associated with the spread of the probability density function for the adjacent message level, and Lev(i+1) is the mean value for the (i+1)-th message level.

8. (Original) The receiver according to claim 7, wherein the distance $d(i) > d_{min}$ for all message levels.

9. (Currently amended) The receiver according to claim 7 [[1]], wherein, for at least two message levels ~~the processor includes means for determining a distance d(i) between received signal levels~~, the respective distances d(i) ~~having~~ have different values~~ for a plurality of message levels~~.

10. (Currently amended) A method of forming a constellation design having a selected number of message levels, the constellation design forming part of a receiver that identifies a transmitted message based upon a received signal, the method comprising:

determining a minimum threshold and a maximum threshold representing a range for each of a plurality of possible ~~signal~~ message levels~~, wherein the sizes of the ranges are different for at least two of the message levels~~, and

calculating ~~the~~ distance d(i) between the maximum threshold for an i-th ~~possible~~ signal level ~~(i)~~ and the minimum threshold for an adjacent (i+1)-th ~~possible signal~~ message level ~~(i+1)~~, where i is an index that identifies an i-th message level, wherein, for each of the possible message levels, the step of determining comprises: (A) determining a respective probability density function having a mean value and a spread; and (B) based on said mean value and said spread, generating the respective minimum threshold and the respective maximum threshold.

11. (Currently amended) The method according to claim 10, wherein the ~~determining~~ step of determining the minimum threshold and the maximum threshold comprises the steps of:

~~identifying a probability density function for each possible signal level Y, and~~

for each of the possible signal levels, identifying the minimum and maximum thresholds as ~~the~~ boundaries of a range, which has a probability ~~in the identified probability density function wherein the probability~~ of correctly ~~receiving a selected~~ identifying the transmitted message level that exceeds a selected probability P0.

12-13. (Canceled)

14. (Currently amended) The method according to claim 10 [[13]], further including the step of calculating the distance d(i) in accordance with the equation:

d(i) = Lev(i+1) – Lev(i) – Lmse(i+1) – Lmse(i),~~;~~

~~wherein the term "i+1" identifies a message level adjacent the i^{th} message level in the constellation design for the receiver and wherein~~ where Lmse(i) is a mean square error associated with the spread of the probability density function for the ~~i^{th}~~ i-th message level, Lmse(i+1) is a mean square error associated with the spread of the probability density function for the adjacent ~~the level mean square error for the i^{th}~~-message level, Lev(i) is the mean value for the i-th message level, and Lev(i+1) is the mean value for the (i+1)-th message level.

15. (Currently amended) The method according to claim 10 [[13]], further comprising the step of ~~identifying~~ determining whether the calculated distance d(i) > d_{min}, wherein d_{min} represents a selected minimum value.

16. (Original) The method according to claim 15, further comprising the step of adjusting the constellation design such that the distance d(i) > d_{min} for all received signal levels in the constellation design.

17. (Currently amended) The method according to claim 14 [[12]], further comprising the step of calculating the mean value, Lev(i), according to the equation:

$$Lev(i) = \frac{1}{N}\sum_{k=1}^{N} L(k),$$

where~~in~~ L(~~i~~k) ~~is the~~ designates training data points received by the receiver, and

N is the number of times that a training signal corresponding to the i-th message ~~training data for the i^{th}~~ level is sent.

18. (Currently amended) The method according to claim 17, further comprising the step of calculating ~~the~~ a standard mean square error, σ^2, according to the equation:

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N}[L(i) - Lev(i)]^2 .$$

19. (Currently amended) The method according to claim 18, further comprising the step of calculating ~~the~~ a mean square error for the i-th message level, Lmse(i), according to the equation:

Lmse = $\alpha\sigma^2$,

where α is a coefficient parametrically defined by the following equation:

$$P0 = \frac{\int_{-\alpha\sigma^2}^{\alpha\sigma^2} e^{\frac{-x^2}{2\sigma^2}}dx}{\int_{-\infty}^{\infty} e^{\frac{-x^2}{2\sigma^2}}dx}$$

, where P0 is a selected probability and x is an integration variable.

20. (Canceled)

21. (Currently amended) A method of identifying a message based upon a received signal, the method comprising:

receiving the signal,

providing a minimum threshold and a maximum threshold representing a range for each of a plurality of possible message levels~~, wherein the sizes of the ranges are different for at least two of the message levels~~, and

identifying the message by comparing the received signal with the generated minimum and maximum thresholds, wherein, for each of the possible message levels, the step of providing comprises:
(A) determining a respective probability density function having a mean value and a spread; and
(B) based on said mean value and said spread, generating the respective minimum threshold and the respective maximum threshold.

22. (Original) The method according to claim 21, wherein the minimum and maximum thresholds are generated as a function of an interrelationship between noise and the message level.

23. (Original) The method according to claim 22, wherein the minimum and maximum thresholds are generated as a function of the interrelationship between digital impairment and the message level.

24. (Original) The method according to claim 22, wherein the minimum and maximum thresholds are generated as a function of the interrelationship between coherent noise and the message level.

25. (Currently amended) The method according to claim 21, ~~further comprising the step of~~ wherein, for each of the possible message levels, ~~calculating a variable range Lmse(i) for each possible message level Y, Lmse(i) representing one-half the distance between the minimum and maximum thresholds for each possible message level, wherein~~ the respective minimum and maximum thresholds define a range wherein the probability of correctly identifying the respective message ~~receiving a selected signal~~ exceeds a selected probability P0.

26. (Currently amended) The method according to claim 25, ~~further~~ including the step of calculating the mean value, Lev(i), where i is an index that identifies an i-th message level ~~within a selected range defined by a selected set of minimum and maximum thresholds~~.

27. (Currently amended) The method according to claim 26, ~~further~~ including the step of calculating a distance d(i) ~~between received signal levels, the distance d(i) being calculated~~ according to the equation:

d(i) = Lev(i+1) – Lev(i) – Lmse(i+1) – Lmse(i),

where Lmse(i) is a mean square error associated with the spread of the probability density function for the i-th message level, Lmse(i+1) is a mean square error associated with the spread of the probability density function for an adjacent (i+1)-th message level, and Lev(i+1) is the mean value for the (i+1)-th message level.

28. (Currently amended) The method according to claim 27 [[21]], ~~further including the step of determining a distance d(i) between received signal levels,~~ wherein, for at least two of the possible message levels, the respective distances d(i) ~~having~~ have different values ~~for a plurality of message levels~~.

29. (Canceled)

30. (Currently amended) The method according to claim 27 [[28]], further comprising the step of ~~identifying~~ determining whether the calculated distance $d(i) > d_{min}$, where~~in~~ d_{min} represents a selected minimum value.

31. (Currently amended) The method according to claim 30, further comprising the step of adjusting a constellation design such that the distance $d(i) > d_{min}$ for all ~~received signal~~ message levels in the constellation design.

32-33. (Canceled)

34. (Currently amended) The method according to claim 26 [[33]], further comprising the step of calculating the mean value, Lev(i), according to the equation:

$$Lev(i) = \frac{1}{N}\sum_{k=1}^{N} L(k),$$

where~~in~~ L(i~~k~~) ~~is the~~ designates training data points ~~received by the receiver~~, and

N is the number of times that a training signal corresponding to the i-th message ~~training data for the i^th^~~ level is sent.

35. (Currently amended) The method according to claim 34, further comprising the step of calculating ~~the~~ a standard mean square error, σ^2, according to the equation:

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{N} [L(i) - Lev(i)]^2 .$$

36. (Currently amended) The method according to claim 35, further comprising the step of calculating ~~the~~ a mean square error for the i-th message level, Lmse(i), according to the equation:

Lmse = $\alpha\sigma^2$,

where α is a coefficient parametrically defined by the following equation:

$$P0 = \frac{\int_{-\alpha\sigma^2}^{\alpha\sigma^2} e^{\frac{-x^2}{2\sigma^2}} dx}{\int_{-\infty}^{\infty} e^{\frac{-x^2}{2\sigma^2}} dx}$$, where P0 is a selected probability and x is an integration variable.

37-39. (Canceled)

40. (Previously presented) A method of forming a constellation design having a selected number of (i) message levels, the constellation design forming part of a receiver that identifies a transmitted message based upon a received signal, the method comprising:

determining a minimum threshold and a maximum threshold representing a variable range for each of a plurality of possible signal levels in the constellation design, and

calculating the distance d(i) between possible signal levels based upon the determined minimum and maximum thresholds, including the steps of:

determining the mean value, Lev(i), for a selected variable range identified by a selected set of minimum and maximum thresholds, and

calculating the distance d(i) as a function of Lev(i) in accordance with the equation:

d(i) = Lev(i+1) – Lev(i) – Lmse(i+1) – Lmse(i);

wherein the term "i+1" identifies a message level adjacent the i^{th} message level in the constellation design for the receiver and wherein Lmse(i) is the level mean square error for the i^{th} message level.

41. (Previously presented) A method of forming a constellation design having a selected number of message levels, the constellation design forming part of a receiver that identifies a transmitted message based upon a received signal, the method comprising:

determining a minimum threshold and a maximum threshold representing a range for each of a plurality of possible signal levels;

calculating the distance d(i) between possible signal levels based upon the determined minimum and maximum thresholds, including the steps of:

determining the mean value, Lev(i), for a selected variable range identified by a selected set of minimum and maximum thresholds, and

calculating the distance d(i) as a function of Lev(i);

identifying whether the calculated distance $d(i) > d_{min}$, wherein d_{min} represents a selected minimum value; and

adjusting the constellation design, when $d(i) \leq d_{min}$.

42. (Canceled)

43. (Previously presented) A method of identifying a message based upon a received signal, the method comprising:

receiving the signal,

generating a minimum threshold and a maximum threshold representing a variable range for each of a plurality of possible message levels in a single constellation design, and

identifying the message by comparing the received signal with the generated minimum and maximum thresholds, wherein the generating step includes the step of calculating a variable range Lmse(i) for each possible message level Y, Lmse(i) representing one-half the distance between the minimum and maximum thresholds for each possible message level, wherein the minimum and maximum

thresholds define a range wherein the probability of correctly receiving a selected signal exceeds a selected probability P0.

44. (Previously presented) A method of identifying a message based upon a received signal, the method comprising:

receiving the signal,

generating a minimum threshold and a maximum threshold representing a variable range for each of a plurality of possible message levels in a single constellation design,

identifying the message by comparing the received signal with the generated minimum and maximum thresholds, and

determining a distance d(i) between received signal levels, the distance d(i) having different values for a plurality of message levels, including the steps of:

determining the mean value, Lev(i), for a selected variable range identified by a selected set of minimum and maximum thresholds, and

calculating the distance d(i) as a function of Lev(i).

45-50. (Canceled)

51. (Previously presented) The method according to claim 41, wherein the step of adjusting comprises removing from the constellation design a message level that gives rise to $d(i) \leq d_{min}$.

52. (Previously presented) The method according to claim 41, wherein the sizes of the ranges are different for at least two of the message levels.